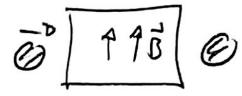
4.8 For spin-½ state evolves with time)



for same time

$$\boxed{i\hbar \frac{\partial}{\partial t} |\Psi(t)\rangle = \hat{H} |\Psi(t)\rangle}$$

Hamiltonian.

If $\hat{H}$ is <u>time independent</u>

$$\boxed{|\Psi(t)\rangle = \underbrace{e^{-i\hat{H}t/\hbar}}_{\hat{U}(t)} |\Psi(0)\rangle}$$

For spin-½ particle in $\vec{B}$ - field what is $\hat{H}$?

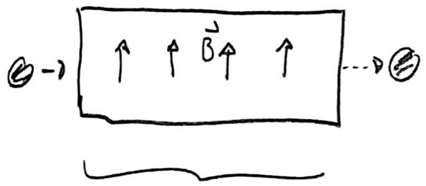
$$\hat{H} = \underbrace{-\frac{gq}{2m}}_{\gamma} \frac{\hbar}{2} \vec{B} \cdot \hat{\vec{\sigma}}$$

$$\hat{H} = \frac{\gamma\hbar}{2} \left[B_x \hat{\sigma}_x + B_y \hat{\sigma}_y + B_z \hat{\sigma}_z\right]$$

so

$$\boxed{\hat{U}(t) = e^{-i\gamma[B_x \hat{\sigma}_x + B_y \hat{\sigma}_y + B_z \hat{\sigma}_z]t/2}}$$

known describes how particle responds to $\vec{B}$ field



known γ factor

time t

① Suppose $\vec{B} = B\hat{z}$ with known γ, t

a). Determine $\hat{U}(t)$

b) Suppose $|\psi(0)\rangle = |+\hat{z}\rangle$ get $|\psi(t)\rangle = |+\hat{n}\rangle$

$t=0$

what direction

Suppose $|\psi(0)\rangle = |+\hat{x}\rangle$ get $|\psi(t)\rangle = |+\hat{n}\rangle$

what direction

② Suppose $\vec{B} = B\hat{y}$

a) Determine $\hat{U}(t)$

b) Suppose $|\psi(0)\rangle = |+\hat{z}\rangle$ get $|\psi(t)\rangle = |+\hat{n}\rangle$

what direction

③ How does this relate to estimating λ in

$$\hat{U}(\lambda) = e^{-i\lambda\hat{\sigma}_z/2}$$

λ corresponds to what?